



Evidence for
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Education

Globalization of Science Curricula

An investigation using TIMSS data

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Aims of the research

Project had three main research questions:

1. Have there been changes in intended science curricula over the last 20 years?
2. Do the changes in curricula support the hypothesis that science curricula are becoming increasingly similar across countries?
3. Are there groups of countries where curricula are becoming increasingly integrated? Can an international core curriculum in science be identified?

Research questions

RQ1 Have there been changes in intended science curricula over the last 20 years?

RQ2 Do the changes in curricula support the hypothesis that science curricula are becoming increasingly similar across countries?

RQ3 Are there groups of countries where curricula are becoming increasingly integrated? Can an international core curriculum in science be identified?

Methodologies used

- Literature review
- Coding of TIMSS science curriculum questionnaire data
- Literature review
- Cluster and discriminant analysis of TIMSS science curriculum questionnaire data
- Coding of TIMSS science curriculum questionnaire data
- Cluster and discriminant analysis of TIMSS science curriculum questionnaire data



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RQ1 Have there been changes in intended science curricula over the last 20 years?

Type of Response	Description of Response	Examples
Changes to content of curriculum (Kiamanesh, 2000; Hussein & Hussain, 2000)	Extra topics added to the science curriculum.	Iran, Kuwait
Changes to Skills emphasis in curriculum (Geske & Kangro, 2000)	Greater emphasis on practical and problem-solving skills	Latvia
Changes to structure and organization of curriculum (Noveanu & Noveanu, 2000)	Introduction of an integrated primary curriculum	Romania
Increased status of science within education system (Gudmundsson, 2000)	More time allocated to science teaching in primary schools	Iceland



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RQ1 Have there been changes in intended science curricula over the last 20 years?

Comparison	Number of countries	Average number of topics added	Average number of topics removed	Average number of topics unchanged
Grade 4				
2003 - 2007	21	2.95 (2.66)	1.76 (2.09)	15.67 (2.92)
2007 - 2015	18	3.44 (2.77)	2.39 (2.21)	12.50 (4.76)
2003 - 2015	26	3.08 (3.19)	2.12 (2.21)	14.88 (3.15)
Grade 8				
1999 - 2007	25	1.88 (2.01)	1.64 (1.98)	15.8 (4.05)
2007 - 2015	36	2.08 (2.11)	1.44 (1.80)	15.42 (3.07)
1999 - 2015	23	2.65 (2.74)	1.39 (1.55)	15.13 (3.07)



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RQ2 Do changes support the hypothesis that science curricula are becoming increasingly similar across countries?

We used cluster analysis to investigate the existence of convergence in science curricula in different countries over time.

Curriculum convergence would be signaled by the tendency of countries to cluster into fewer groups or by the emergence of one group that expands at the expense of others.



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Grade 4 Results by Cluster and Discriminant Analysis

	Number (and percentage) of countries by group		
	2003	2007	2015
Group 1	16 (55.17%)	35 (76.09%)	37 (69.81%)
Group 2	13 (44.83%)	11 (23.91%)	16 (30.19%)

Group 1 increases by 14.6% points

No clear evidence for convergence



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Grade 8 Results by Cluster and Discriminant Analysis

	Number (and percentage) of countries by group		
	1999	2007	2015
Group 1	20 (52.63%)	9 (15.52%)	3 (6.67%)
Group 2	18 (47.37%)	49 (84.48%)	42 (93.33%)

Group 2 increases by 46% points

Good evidence for convergence

- The pattern of convergence at grade 4 and grade 8 is reflected in countries appearing in consecutive cycles and new entrant countries. It is unlikely that these are effects caused by the changes to the cohort.
- Reverse analysis (to test for divergence of curricula) shows no clear evidence at grade 4 (from 2007 to 2003) and no evidence at grade 8.

	2015	2007	2003	1999
Grade 4 (group 1)	58%	57%	76%	
Grade 8 (group 2)	80%	76%		84%



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RQ2 Do changes support the hypothesis that science curricula are becoming increasingly similar across countries?

Grade 4 – no clear evidence for convergence or divergence. Suggests changes are happening but no clear direction for changes.

Grade 8 – good evidence for convergence and no evidence for divergence. Suggests that changes are making the curricula more aligned.



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RQ3 Are there groups of countries where curricula are becoming increasingly integrated?

- **Grade 4:** No clear pattern emerged
- **Grade 8:** Group 1 contained a higher number of North African and Middle Eastern countries including Morocco, Lebanon, Dubai and Bahrain. In addition, no Western European countries were present, suggesting that at this grade there was some country clustering along geographic and cultural lines.



RQ3 Can an international core curriculum in science be identified?

Topics taught in 80% of participating countries

Grade 4 topics	2003	2007	2015
Life sciences (7)	1	3	4
Physical sciences (9)	1	1	1
Earth sciences (5)	0	1	2

Grade 8 topics	1999	2007	2015
Biology (7)	5	6	4
Chemistry (4)	1	1	3
Physics (5)	4	3	3
Earth sciences (4)	3	2	4



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Which countries made the most changes (baseline to 2015)?

Changes	Grade 4 countries	Grade 8 countries
1-3	Singapore	Hungary, Hong Kong, Jordan, Turkey, USA, Iran, Chinese Taipei
4-6	England, Lithuania, Russia, Italy, Hungary, Ontario, Slovenia, USA	England, Japan, Malaysia, Slovenia, Thailand, Australia, Canada, Italy, Lithuania, New Zealand, Chile, Rep. of Korea, Russia
7-10	Chinese Taipei, Cyprus, Hong Kong, Japan, New Zealand, Norway	Singapore, Morocco
More than 10	Australia, Morocco, Belgium (Flemish)	South Africa, Israel



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Which countries made the most changes (baseline to 2015)?

Grade	Country	Baseline rank	Number of changes	Category
4	Chinese Taipei	2/25	10	Top end competitors
4	Japan	3/25	7	Top end competitors
4	Hong Kong SAR	4/25	9	Top end competitors
8	Singapore	2/38	8	Top end competitors
4	Australia	11/25	12	Mid ranking changers
4	New Zealand	12/25	8	Mid ranking changers
4	Belgium (Flemish)	13/25	15	Mid ranking changers
4	Cyprus	19/25	7	Below average responders
4	Norway	20/25	10	Below average responders
4	Morocco	25/25	13	Below average responders
8	Israel	26/38	11	Below average responders
8	Morocco	37/38	10	Below average responders
8	South Africa	38/38	12	Below average responders

Limitations

There are a number of limitations to our methodological approach, for example:

- It focuses mainly on intended curricula
- It references only topics that are common across cycles of the TIMSS framework and form part of science curricula
- Reliant upon accurate completion of curriculum questionnaire
- It only considers countries participating in TIMSS
- Does not take into account other large scale international assessments



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Overall Conclusions in Brief

Have there been changes in intended science curricula over the last 20 years?

All countries who have participated in TIMSS have made at least some curricular changes in terms of the TIMSS science topics.

Changes are more likely to be the addition of topics to the curriculum rather than removal.

- *There are more changes at grade 4 than for grade 8.*



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Overall Conclusions in Brief

Do the changes in curricula support the hypothesis that science curricula are becoming increasingly similar across countries?

- *Cluster and discriminant analysis show no clear evidence for this at grade 4.*
- *Cluster and discriminant analysis do provide evidence for the convergence of curricula at grade 8.*



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Overall Conclusions in Brief

Are there groups of countries that are becoming increasingly integrated?

- *Not enough data available to give a definitive answer.*
- *We have identified 'groups' of countries that have made significant changes to their curricula.*

Can the basis of an international core curriculum in science be identified?

- *Grade 4 – more life science topics are taught in more than 80% of countries.*
- *Grade 8 – the pattern of topics taught has become more balanced across the scientific disciplines.*



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The NFER team

Assessment researchers	Statistical analysis	Library services
Oliver Stacey	Guilia de Lazzari	Hilary Grayson
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NFER provides evidence for excellence through its independence and insights, the breadth of its work, its connections, and a focus on outcomes.

Thank you

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